FOREST ANALYSIS BRANCH

Supplemental Guide for Preparing Timber Supply Analysis Data Packages

June 2003

106-01670/

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1 Introduction

This document is intended to help guide the preparation of the data package, a key component of the timber supply analysis that is required as part of the provincial Timber Supply Review. The timber supply analysis forms the major body of technical information used by the chief forester to determine allowable annual cuts (AACs) for Timber Supply Areas (TSAs) under Section 8 of the *Forest Act*.

Under the Defined Forest Area Management (DFAM) initiative, responsibilities for performing timber supply analyses and other activities related to the TSR in TSAs will be transferred to groups of licensees (DFAM Groups). Specific standards associated with the timber supply analysis are described in the companion document *Interim Standards for Data Package Preparation and Timber Supply Analysis*.

This guide has been developed to support the above standards. The recommendations in this guide are not mandatory requirements but provide suggested procedures and practices that are consistent with the standards. The guide describes the purpose of the Timber Supply Analysis Data Package (DP), the obligations, roles and responsibilities of different parties, and provides a suggested format for submission of data and information needed for timber supply analysis. The guide will be useful to DFAM groups, as well as to staff from the Ministry of Forests (MoF), the Ministry of Sustainable Resource Management (MSRM), the Ministry of Water Land and Air Protection (MWLAP) and other agencies.

This document is subject to periodic revision. Please ensure you have the most up-to-date version by checking the Forest Analysis Branch internet site at http://www.for.gov.bc.ca/hts

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1.1 Purpose of the data package

The purpose of the timber supply analysis data package is to:

- provide a detailed account of the management unit-specific land base, growth and yield, and management assumptions related to timber supply that the chief forester must consider under the *Forest Act* when determining an allowable annual cut (AAC) and how these will be applied and modelled in the timber supply analysis;
- provide a means for communicating data inputs and analysis methodology among licensees, MoF, MSRM, and MWLAP staff, and other users;
- provide MoF staff with the opportunity to review data and information that will be used in the timber supply analysis before it is initiated;
- ensure that all relevant information is accounted for in the analysis to a standard acceptable to MoF staff;
- provide the evidentiary basis for the information used in the analysis;

The format presented in this guide closely follows the approach used for TFLs in previous Timber Supply Reviews. However, like the existing TFL process, and in recognition of the varied information sources and models in use in the province, it is not a requirement that the format be followed exactly. Licensee's are encouraged to adjust the format to best suit the situation of each management unit. However, significant changes to the format presented here or departures from the modelling methods suggested in this document should be discussed with the MoF reviewing analyst before proceeding.

The data package provides information on:

1. Forest and other resource inventories and adjustments;
2. Definition of the land base suitable for timber harvesting;
3. Classification of the land base into management zones and growth and yield classes (analysis units);
4. Development and provision of timber growth and yield information;
5. Forest protection and salvage;
6. Resource management emphasis;
7. Timber supply analysis methods, including model choice and management scenarios.

1.2 Process

The MoF has a key role in reviewing and accepting the data package and the analysis. The MoF may also provide technical support, facilitate resolution of issues, and validate technical information. Various resource specialists in MSRM and MWLAP may also play key roles. The following table shows the general roles and responsibilities associated with the timber supply analysis leading to an AAC determination.

Table 1. Roles and responsibilities

DFAM group obligations	Government obligations
• Collect and prepare a data package	• Set standards for the data package • Review and accept the data package
• Complete an analysis for the TSA	• Set standards for the analysis • Review and accept the analysis
• Provide information to the public and First Nations	• Consult with First Nations • Determine the AAC for each TSA

2 Inventory and model files

Provide the detailed inventory file (digital ASCII format) that includes the definition of the timber harvesting land base for the base case (that is, after application of all land base deductions), and all management zones and analysis units. Files should include or be accompanied by detailed field descriptors. Specific requirements are described in *Interim Standards for Data Package Preparation and Timber Supply Analysis*. The information will enable the MoF reviewing analyst to review the land base reductions applied, as well as facilitate provincial-level strategic analyses.

Similar information to the above for other options or sensitivity analyses may be requested by the MoF reviewing analyst should she/he consider it necessary to gain a better understanding of the timber supply on the management unit.

The reviewing analyst may generate reports from the files provided, or request summary reports from the licensee to provide Forest Service field staff with information they may need to provide effective input into the evaluation of the data package.

With respect to the forest cover inventory, the following information is useful for understanding land base definition methods and growth and yield issues, and facilitating interpretation of results:

- the standards and format (VEG, FIP) of the inventory;
- the update year;
- the projection year; and
- any adjustments applied;
- a description of, and reasoning for changes or corrections made to the inventory for this analysis (e.g. changes to polygon labels); and
- the date of the original inventory or re-inventories;
- any other information that is necessary for a complete understanding of the inventory and any uncertainties associated with it, including relevant audits or studies.

2.1 Attribute adjustments

If Vegetation Resource Inventory (VRI) Phase 2 adjustments are to be applied, provide or reference a report describing the adjustment factors and methods to be used.

3 Land Base

3.1 Timber harvesting land base definition

The data package should contain a description of issues, information sources, assumptions, and criteria used to estimate the land base available for timber harvesting, including any relevant data processing or adjustments.

Table 2 provides an example format for summarizing the area reductions made to the total area of the management unit to arrive at the land base that is available for timber harvesting. In such a table, list reductions and additions to the total land base in the order in which they are applied. Each reduction and addition should be described in detail in the sections following.

Some of the land base and volume reductions and additions listed in the table may not apply to every management unit. Conversely, other reductions or additions may apply in other management units. The following table should be used as a guide for designing a table that best represents the management unit being analysed. Where appropriate, licensees should explain why any of the listed categories were not considered in the timber harvesting land base definition.

Table 2. Timber harvesting land base determination

	Total productive forest by classification (ha)	Area excluded (ha)	Percent of total area	Percent of productive forest
Total area (incl. fresh water)				
Private, federal, WL, other ownership areas outside management unit				
Non-forest				
Non-productive forest				
Parks and ecological reserves				
Total Crown managed productive forest[1]				
Reductions from the productive forest area:				
Inoperable/inaccessible				
Non-commercial				
Low site				
Non-merchantable				
Non-timber resources				
e.g. environmentally sensitive areas				
e.g. riparian reserves				
e.g. winter range				
e.g. wildlife tree patches				
Other exclusions				
Unclassified roads, trails and landings				
Total reductions to productive forest:				
Volume reductions (if any)				
Total reduced land base (including NSR)				
Additions to reduced land base:				
e.g. species conversion				
Timber harvesting land base				
Less:				
Future roads, trails and landings				
Long-term timber harvesting land base				

(1) Productive forest in this context denotes the forest area that contributes to forest management objectives, such as landscape-level biodiversity, wildlife habitat and visual quality

Explain and quantify any changes to the total land base resulting from any boundary revisions since the last timber supply analysis.

For each category shown in the table, document both the total productive area in the management unit classified as belonging in the category (i.e., including any overlaps with other categories that were deducted earlier in the land base reduction process) and the area that is deducted to determine the timber harvesting land base.

3.2 Exclusions from the Timber Harvesting Land Base

3.2.1 Administrative classes that do not contribute to TSA forest management objectives

With FIP files (pre-VRI), ownership codes were generally used to identify if land was expected to contribute to forest management objectives, and timber supply specifically, in a TSA. Areas designated as ownership code 62C or 69C were included in the productive forest, and other types such as private land, Indian reserves, ecological reserves, parks, woodlots, etc, were excluded.

Procuring up-to-date ownership information can be difficult, and it is likely that separate coverages for the various classifications may need to be overlaid to generate ownership information.

Regardless of what information is available, the purpose of the administrative, or ownership, exclusion is to remove areas from further consideration in the analysis that, because of their administrative classification, will not contribute to forest management objectives for the TSA.

3.2.2 Non-forest and non-productive forest

For older inventories based on the Forest Inventory Planning (FIP) format, list and characterize the areas classified as non-forest and non-productive as shown in the table below. Generalized information is typically identified by *type identity code* and/or *non-forest* and *non-productive* descriptors.

Table 3. Non-forest area

Description	Total area (hectares)
Fresh water	
Classified roads	
Urban	
Total	

Unlike the FIP format, the newer VRI or VEG formats do not contain "cultural" or interpreted variables for non-productive forest. However, timber supply analysis still requires definition of a forest land base that contributes to forest management objectives, such as landscape-level biodiversity, wildlife habitat and visual quality.

There are no standards for defining this forest management land base, which will be called the "total managed productive forest" in this guide. It will be up to the DFAM group to determine the extent of the forest that can reasonably be expected to contribute for management objectives, and to document the criteria used. VRI variables such as BC land cover class, land cover component, crown closure, and site index can be useful for defining this land base. It is likely that other land base deductions, such as operability, merchantability and site productivity will address timber harvesting and production related issues, so there is not a strong need to delineate the Crown managed productive forest using criteria related strictly to timber productivity. Definition of the total forest area should in most cases focus on the criteria needed for an area to contribute to any forest management objective related to forest cover.

3.2.3 Inoperable/inaccessible

Inoperable areas are areas that are not available for timber harvesting because of adverse terrain characteristics such as steep slopes, unfeasible road access or uneconomic yarding or flight distance. Specific geographic areas (e.g., planning cells) may be identified as physically inaccessible to timber harvesting. Stand attributes from the inventory (e.g., slope, soil type, terrain class) also may be used to account for areas not available to timber harvesting. In the data package, describe the methods and criteria used in the operability classification system (e.g., lines drawn by field staff, methods documented in a specified report, etc.), and provide areas in each category (see Table 4). Classification by harvest method will be covered in more detail later under Section 9.2 'Harvest systems'.

Table 4. Inoperable land base

Criteria (include detailed description below if this space is not sufficient)	Crown managed productive forest area (hectares)	Area excluded (hectares)
e.g. Physically inaccessible with current technology		
e.g. Classified as inoperable on inventory file		
e.g. Steep slopes		
Total		

3.2.4 Non-commercial cover

Specify the amount of non-commercial cover that exists on the management unit where timber production is considered to be unlikely. If species conversion is planned for these sites, the management assumptions should be documented under Section 6.4, 'Stand rehabilitation'.

Table 5. Non-commercial cover

Description	Crown managed productive forest area (hectares)	Area excluded (hectares)
e.g. NC brush		
Total		

3.2.5 Low productivity sites

Low productivity sites are areas that are not suitable for timber harvesting due to low timber growing potential (i.e., site quality). Document the criteria used to identify and exclude low productivity sites (see following table). If site class mid-points are used, document the range of the site classes excluded. Evidence of historic harvesting activity in low productivity areas assumed to be within the THLB may be provided to confirm the assumptions made for the base case.

For purposes of the AAC determination it is clearer if low productivity sites are identified separately from stands that currently have insufficient volumes or timber quality and size to be merchantable. For non-merchantable sites identified using minimum diameter limits and/or volume per hectare limits, refer to Section 3.2.6, "Non-merchantable forest types" below.

The "area excluded" reported in Table 6 below should equal the low site reduction reported in the *Timber harvesting land base definition* table (Table 2).

Table 6. Low site

Leading species	Upper site index threshold	Diameter at breast height (cm) at upper limit of low site	Volume/hectare (m^3/ha) at upper limit of low site	Total Crown managed productive forest (ha)	Area excluded (ha)	Volume excluded (m^3)	Average volume/ hectare (m^3/ha) excluded
Total							

Note: "Upper" limit means the site index threshold below which stands are not suitable for harvest.

3.2.6 Non-merchantable forest types

Non-merchantable forest types are stands that contain tree species not currently utilized, or timber of low quality, small size and/or low volume. Non-merchantable types may be wholly or partially excluded from the timber harvesting land base. Examples are balsam-, cedar- and hemlock-leading stands that contain a high proportion of decay; overstocked pine stands; and deciduous-leading (hardwood) stands in areas of the province where they are not considered economically viable.

Document the stand types that are currently considered to be non-merchantable forest types (see following table). The land base reductions are typically described according to inventory file attributes (e.g., type group, site index breaks, age, height, stocking, minimum volume per hectare and/or minimum average stand diameter).

Where deciduous species cover a significant area and/or where deciduous species warrant specific consideration, it is helpful to describe any related land base exclusions under a separate heading. Where the deciduous trees in conifer/deciduous stands are not utilized, exclusion of deciduous volumes from yield tables is a more appropriate modelling method than a land base exclusion (see volume reductions under the Growth and Yield section below).

Table 7. Non-merchantable forest types

Zone/ group	Inventory type group	Characteristics						
		e.g. Age	e.g. Height	e.g. Stocking	Total area (hectares)	Reduction percent (%)	Area deducted (hectares)	Area remaining (hectares)

3.2.7 Environmentally sensitive areas

Environmentally sensitive sites and areas of significant value for other resource uses have been delineated as environmentally sensitive areas (ESAs). ESAs cover sensitive soils (Es), forest regeneration problems (Ep), snow avalanche risk (Ea), recreation values (Er), wildlife habitat (Ew), and water use (Eh).

ESA inventories are gradually being replaced by more detailed and current inventories of forest resources, such as terrain evaluations and wildlife habitat mapping. Nevertheless, for some areas and resources the ESA inventory still constitutes the best available information.

In the context of timber supply analysis, two approaches are typically used to account for any reduction in harvesting opportunity associated with ESAs: 1) percent area reductions, and 2) site-specific evaluation of individual ESA polygons to determine if they should be excluded from the timber harvesting land base.

For areas that are not accounted for through a more specific inventory (e.g., a terrain assessment), document how much area is not available for timber harvesting because of their classification as ESAs (e.g., Table 8).

Also document deductions for other non-timber resources not specifically listed in this guide for which a land base deduction most appropriately reflects management objectives and practices. The total deduction reported in the ESA table should equal the ESA deduction identified in the *Timber harvesting land base definition* table (Table 2).

Table 8. Area reductions for ESAs

ESA category	ESA description	Total Crown managed productive forest area (ha)	Percent reduction	Area (hectares) excluded		
				Operable	Inoperable	Total
e.g. Er1						
e.g. Er2						
Total						

3.2.8 Riparian reserves and management zones — streams

3.2.8.1 Riparian reserves

If a comprehensive stream class inventory is available for all or a portion of the management unit, determine the area of reserve zones to be excluded from the timber harvesting land base in accordance with Table 1 (page 14) of the *Riparian Management Area Guidebook*.

Where a stream inventory has not yet been completed for the entire management unit, estimate the area in riparian reserve zones. For example, if it is available, local information may be used to estimate the reserve zone area (e.g., surveys of average stream density distribution by class, or comprehensive stream inventory of watersheds that are representative of general conditions in the management unit). Provide a detailed description of the procedures and assumptions used to compile local estimates. It is recommended that these procedures be developed in consultation with, and with the agreement of, local MSRM and/or MWLAP staff.

If gullies cover sufficient area to warrant land base reductions in addition to riparian reserves, the method used to identify the gullies, the management strategies (such as those described in the *Gully Assessment Procedures Guidebook*) and the area affected should be documented. Table 9 below provides an example format.

3.2.8.2 Riparian management zones

Management practices within riparian management zones may be reflected in the analysis using several methods:

- a land base exclusion;
- a volume reduction;
- a forest cover requirement.

A land base reduction would reflect an effective reserve width calculated based on the retention percentages used in the management zones, or as documented in Table 4 of the *Riparian Management Area Guidebook*. The land base reduction for management zones would be added to the riparian reserve zone width.

A volume reduction or a forest cover requirement could also be designed to reflect management practices in riparian management zones.

In the base case the method that best reflects current performance should be used. Note that if stems retained in the riparian management zone do not meet the minimum diameter of trees that are reflected in the yield tables, they would not contribute to a volume reduction and should not be modelled as such in the analysis.

If possible, provide both the total Crown managed productive forest areas and the excluded area (i.e. given the netdown order) in riparian reserves. Describe the methods used to account for riparian reserve and management zones in the base case and applicable sensitivity analyses and provide information sources.

Table 9. Riparian reserve and management zones — streams

Location (e.g. zone)	Riparian class	Stream length	Reserve width	Reserve area (hectares)	Management zone width	Reduction percent	Management zone area (hectares)	Total area deducted (hectares)

3.2.9 Riparian reserve and management zones — wetlands and lakes

Identify wetlands and lakes in accordance with the *Riparian Management Area Guidebook*. Use Tables 2 and 3 of the *Guidebook* to determine the area within the reserve and management zones.

Provide a detailed description of the information that is available and the procedure used to derive the deductions for wetland and lake reserve and management zones. If possible, please provide both the total Crown managed productive forest areas and the excluded area in wetland and lake riparian reserves.

For areas within the former Kamloops, Nelson and Prince George Forest Regions, the appropriate *Regional Lake Classification and Lakeshore Management Guidebook* is also available. Theses *Guidebooks* should be consulted when determining the appropriate assumptions for the timber supply analysis.

Table 10. Riparian reserve and management zones — wetlands and lakes

Location (e.g. zone)	Riparian class	Length of outer edge	Reserve width	Reserve area (hectares)	Management zone width	Reduction percent	Management zone area (hectares)	Total area deducted (hectares)
	e.g. W1							
	e.g. L2							

3.2.10 Wildlife habitat — land base deductions

Wildlife habitat may be identified and managed through several processes including the *Identified Wildlife Management Strategy*, identification and approval of ungulate winter range (UWR), and management practices specified in higher level plans.

For many management units, wildlife habitat that is sensitive to timber harvesting is identified in the ESA inventory. This inventory is gradually being replaced with more detailed and current habitat mapping. Where no new, up-to-date habitat mapping is available, the ESA inventory may constitute the best available information for the management unit, and also may be used in planning processes. In such cases wildlife ESAs should be used to reflect current performance in the base case of the timber supply analysis.

When preparing the information package, licensees are encouraged to consult with local MWLAP and MoF staff as well as the MoF reviewing analyst to ensure that any new information or policies related to management of wildlife are identified and incorporated in the timber supply analysis.

Depending on the management regime applicable in the habitat areas, land base reductions and/or forest cover requirements are typically used to model management objectives. If a land base deduction is applied, document the source of the habitat information and the reasons for applying a land base deduction (see the following table for an example format). Describe information sources and methods used to estimate the area of wildlife habitat to be excluded. Application of forest cover requirements will be covered later under Section 8 Resource Management Emphasis.

Table 11. Estimates for wildlife habitat no harvest areas

Wildlife species	Identifying variables in inventory (location descriptors)			Total area (hectares)	Percent reduction	Excluded area (hectares)

3.2.11 Cultural heritage resource deductions

A cultural heritage resource is an object, site, or location of a traditional societal practice that is of historical, cultural or archaeological significance to the province, a community, or an aboriginal people. Cultural heritage resources include archaeological sites, structural features, heritage landscape features and traditional use sites. Describe known cultural heritage resources, the areas and appropriate protection or management measures. Current practices for protecting these areas should be reflected in the base case assumptions. Describe the procedures used to estimate cultural heritage resource areas.

Table 12. Cultural heritage resources

Identifying variables in inventory (location descriptors)			Total Crown managed productive forest area (hectares)	Percent (%) reduction	Excluded area (hectares)	Reason for exclusion

3.2.12 Other sensitive site deductions

Document information applicable to any other areas identified as sensitive to timber harvesting, for which land base deductions most appropriately reflect management objectives and practices, and that are not covered under the preceding sections. Discuss the source of the information used, the area affected, any procedures used to estimate affected areas, and the methods used for modelling.

If more current and reliable information for sensitive sites that were traditionally identified as ESAs is available, it should be used in the analysis along with modelling methods that properly reflect the management objectives and practices. For example, if a terrain stability classification has been completed, this information should be used in place of soils ESAs.

Table 13. Other sensitive site reductions

Type	Total Crown managed productive forest area (hectares)	Percent (%) reduction	Excluded area (hectares)	Description
Total				

3.2.13 Roads, trails, and landings

Quantify the area that is, and will be, disturbed by roads, trails, landings (RTLs) and other access features. The exclusions apply to the area expected to remain non-productive. Portions of access routes that are to be permanently deactivated and returned to their original condition should remain in the timber harvesting land base. Plans for road deactivation and methods used to model this activity should also be included in this section.

3.2.13.1 Classified roads, trails, and landings

Table 14 summarizes areas that are currently classified in the inventory as roads, trails, and landings. Usually this area is included in the non-forest land base deduction (see Section 3.2.2, "Non-forest and non-productive forest"). The information presented here should include a breakdown of the area in each disturbance category (i.e., roads, trails, landings). This information may assist in providing estimates for unclassified and future roads, trails and landings.

Table 14. Classified roads, trails, and landings

Location e.g. zone e.g. group	Total area (hectares)		
	Roads	Trails	Landings
Total			

3.2.13.2 Unclassified roads, trails, and landings

The purpose of this section is to document the area that is currently occupied by roads, trails, landings and other access features (e.g., seismic lines, oil well sites) that are not classified in the forest cover inventory. The source of the information and method used to estimate this reduction should be documented in the data package.

In some areas it may be preferable to localize the deductions to broad age classes, zones or groups. For example, large unroaded immature stands of fire origin should not have existing road reduction percentages applied. Conversely, access to cutblocks often runs through old-growth areas where a land base deduction may be warranted.

For all unclassified road deductions, summarize the road length and width (often by road class or category) and describe the methods or surveys used to estimate road widths and lengths. The approach used to estimate the area of landings that is expected to remain non-productive should also be described. Sufficient information should be provided to facilitate review and validation by Forest Service staff.

If rehabilitation of roads and/or landings (e.g., re-contouring) is current practice, information on past and projected rehabilitation activities should be included in the data package and accounted for in the analysis. The method or information source used to derive a productivity reduction for the area of rehabilitated roads should also be described.

Table 15. Access feature classification

Access feature/ class	Road length (kilometres)	Road width (metres)	Area (hectares)

Table 16. Unclassified roads, trails, and landings

	Total area (hectares)			Rehabilitated area (hectares)			Reduction percent (%)	Area deducted
Location e.g. zone e.g. group	Roads	Trails	Landings	Roads	Trails	Landings		
Total								

3.2.13.3 Future roads, trails, and landings

Provide an estimate of the area of all roads, trails, and landings that will be constructed in currently undeveloped areas (mature and immature stands). The following table provides an example format.

The reduction may be applied as a percent reduction equally against all stands that will be disturbed in the future, or as an area reduction to each analysis unit, zone, group, broad maturity class or specific area.

If there are no plans to rehabilitate roads and restore road areas to a productive capacity, stands will provide harvest volume on the first entry but not on further entries. Plans for rehabilitation should only be included in the base case if a road rehabilitation program is currently in place on the management unit. Information on current performance including the method and applicable data sources should be provided to support the modelling assumptions.

The area contributing to the long-term harvest level is net of the area that will be covered by roads in the future.

Table 17. Future roads, trails, and landings

Location e.g. zone e.g. group	Total area (hectares)			Rehabilitated area (hectares)			Reduction percent (%)	Area deducted
	Roads	Trails	Landings	Roads	Trails	Landings		
Total								

3.2.14 Other land base exclusions

The purpose of this section is to specify the location and total area to be excluded from the timber harvesting land base for any resource concerns other than those discussed in previous sections, and that are most appropriately accounted for through land base reductions. The information source and the method used to estimate the area, as well as any other information that is pertinent to modelling these assumptions, should be included in the data package. Examples are parks or wilderness areas designated by Order-in-Council that are not already accounted for on the inventory file.

While areas recognized in legislation or by Order-in-Council as not contributing to the timber harvesting land base may be excluded, areas which have been deferred from harvesting because they are contentious or are under study (e.g., planning deferrals, potential parks) should not be considered unavailable for timber harvesting in the base case. The ramifications of these potential land base reductions may be explored in other timber supply options or sensitivity analyses.

Table 18. Other land base exclusions

Identifying variables (location descriptors)			Excluded area (hectares)	Reason for exclusion

3.3 Additions to the Timber Harvesting Land Base

Document any areas that are to be added into the timber harvesting land base at some time during the forecast period. A common example of this is the regeneration to conifers ("rehabilitation") of areas that were deducted from the timber harvesting land base as non-commercial cover. Include a description of the information sources and methods used to estimate any area additions in this section.

Table 19. Area additions

Description of area addition	Analysis unit	Timing of addition	Area (hectares)
Total			

4 Management zones and analysis units

4.1 Management zones, groups and objectives

This section describes the criteria and rationale used to delineate areas that are subject to unique forest cover objectives (e.g., to satisfy objectives for wildlife habitat, visual quality, biological diversity, etc.). The purpose here is to describe the types of management zones and objectives. Forest cover requirements to be applied are discussed under Section 8, "Resource Management Emphasis."

Areas may be subject to a single objective, or several overlapping objectives. The various forest-level models used in B.C. use different approaches for modelling forest cover objectives. One approach to employ a hierarchy of spatially unique management zones that may contain overlapping groups (this terminology is specific to FSSIM). In this way, overlapping forest cover requirements can be applied. Regardless of the approach used, due to the increasing amount and complexity of the information that will be generated from timber supply models, it is essential that the procedures used and the information generated is clearly documented and explained in the data package and timber supply analysis report.

Table 20. Zones and groups

Zone/ group	Name	Total area	Net area	Criteria used to delineate zone/group				Rationale/comments
Zone 1	e.g. VQO partial retention			e.g. Highway corridor e.g. All polygons classified as partial retention VQO				e.g. Mapped by John Smith as per regional/provincial landscape guidelines dated June 30/92
Zone 2	e.g. Ungulate			e.g. Fir leading	e.g. ≥ age class 4			e.g. Regional/habitat guidelines dated Dec. 31/91 were followed
Zone 3	e.g. Integrated Resource management			e.g. All areas not covered by other zones				e.g. IRM: 4-pass system with 15 year green-up to account for adjacency constraints
Group 1	e.g. Caribou			Caribou area				e.g. Instructions in letter from regional habitat biologist, dated Feb. 14, 1993, were followed
Group 2	e.g. Landscape unit (LU) 1			Koch Creek watershed				

4.2 Analysis units

To reduce the complexity and volume of information used and generated in timber supply models, individual stands may be aggregated into fewer, larger and more or less homogeneous units called analysis units. Analysis units are usually comprised of combinations of stands with similar tree species, timber growing capability (site index) and sometimes silvicultural management regimes. Yield tables representing the growth of trees on each polygon within the analysis unit are combined to represent the area-weighted average growth of stands on the unit. Yield tables for currently existing and future regenerated stands are developed using this approach.

Often it is warranted to assign analysis units to specified age ranges for a given species/site class combination. For example, when the site index assigned to old-growth stands in the inventory does not reflect the growth potential expected for thrifty stands, separate analysis units may be created for both the old-growth and thrifty components of the species/site range combinations. For example, analysis units may be developed for 'young' stands (0 to approximately 30 years), 'thrifty' (approximately 30 to 140 years) and 'old', (141 years and older).

It may also be warranted to create separate yield tables for similar analysis units in different zones in which they occur. For example, analysis unit 'fir good' in 'zone A' may consist of areas with an average site index that is lower than analysis unit 'fir good' in 'zone B'. For this reason it may be warranted to define two analysis units for 'fir good', one for 'zone A' and one for 'zone B'.

Describe the methods used and reasoning behind the aggregation of the inventory into analysis units. It may be necessary to provide several tables to describe analysis units for mature stands, thrifty stands, existing managed stands and future regenerated stands.

Table 21. Analysis units

Zone/ group	Analysis unit (# and name) e.g.	Net area	Site index	Variable used to define analysis unit				Rationale used or comments[a]
				Species/ type group	Site index range	Age range	Other	
e.g. VQO partial retention	1) S/F GMP 2) Pl GM 3) Pl P			S/F	G (SI 35+)			
e.g. Wildlife	4) S/F GMP 5) Pl/ GMP 6) C/H GMP							
e.g. Caribou	7) All						Entire Caribou zone	
e.g. Normal management	8) S GM 9) S P 10) F GM 11) F P 12 Pl GMP 13) C/H GMP							

(a) The rationale used to define the analysis unit may be obvious based on the variables that were used to define each analysis unit. This column could contain, for example, descriptions of areas that do not fit the criteria of the analysis unit but were aggregated into the analysis unit due to the small size of the area.

5 Growth and Yield

This section should contain clear descriptions of issues, information sources, assumptions, methods, and any relevant data processing or adjustments related to growth and yield estimates for existing and future stands under both unmanaged and managed conditions, including:

- Methods, principles, and information sources underlying site productivity estimates;
- The silvicultural management regimes assumed for regenerated stands;
- Utilization levels and operational adjustments;
- Methods and information underlying site productivity estimates and yield tables that reflect any planned innovative management;
- Any relevant studies;
- The models used in generating timber yield tables;
- The yield tables used for each growth and yield analysis unit (normally species and site quality group and silvicultural regime);

The reviewing analyst from the Ministry of Forests may consult with MSRM Terrestrial Information Branch and/or MoF Research Branch specialists during review of the data package.

5.1 Site index

5.1.1 Site curves

List the site curves used for all species and age groups.

Table 22. Site index source

Species	Source
e.g. Amabilis fir	Kurucz (1982)

If any site index curves are not consistent with the accepted Ministry of Forests standard, please explain the rationale for using alternate curves. Licensees are encouraged to discuss site index curves with MoF Research Branch staff during the development of the data package.

5.1.2 Site index adjustments

Any adjustments to old-growth site index (e.g., paired plot, veteran tree studies, site index biogeoclimatic ecosystem classification) used in the base case, an option or a sensitivity analysis should be explained. Describe the sources of information and methods used. Licensees are encouraged to contact MoF Research Branch staff to discuss potential adjustments to old-growth site indexes during the preparation of the data package.

Table 23. Site index adjustments

Species	Age range	Inventory site index	Adjusted site index	Area (hectares)
e.g. Fd	0–30			
	31–140	12	12	
	140 +	e.g. 12	e.g. 15	

5.2 Utilization level

The utilization level defines the maximum height of stumps that may be left on harvested areas, and the minimum top diameter (inside bark) and minimum diameter at breast height (dbh) of stems that must be removed from harvested areas. These factors are needed to calculate merchantable stand volume for use in the analysis. The utilization levels used in the analysis should reflect the levels currently applied in operations. Please include the firmwood standard where it is not equal to 50 percent.

Table 24. Utilization levels

	Utilization			
Species	Minimum dbh (cm)	Maximum stump height (cm)	Minimum top dib (cm)	Firmwood standard (%)

5.3 Decay, waste and breakage for unmanaged stands

Document the decay, waste and breakage factors by species that are applied to unmanaged stand yield tables to obtain net volumes per hectare. These factors maybe the standard values incorporated into the Variable Density Yield Prediction model, in which case no further description is required.

If alternative factors and assumptions are to used, provide an explanation of how they were derived. Licensees are encouraged to contact MSRM Terrestrial Information Branch, to discuss proposed methods of determining factors and information requirements for the review of the proposed factors.

Table 25. Decay, waste and breakage factors for unmanaged stands

Forest inventory zone (FIZ)	Public sustained yield unit (PSYU) or local	Utilization level (cm dbh)	Age range	Factor by species (%)				
			< 80, 81–120, > 121	F	C	H	B	→ etc.

Table 26. Sources of decay, waste and breakage factors

Factor	Species	Source

5.4 Operational adjustment factors for managed stands

Describe all operational adjustment factors (OAFs) that will be applied order to adjust potential yields generated by growth and yield models (e.g., TASS/TIPSY) to reflect operational factors, such as gaps in stands and decay.

The default factors most commonly used in B.C. today are an OAF 1 of 15 percent and an OAF 2 of 5 percent. OAF 1 is a constant percentage reduction to account for openings in stands, distribution of stems or clumpiness, endemic pests and diseases, and other risks to potential yield. OAF 2 is an increasing percentage reduction that can be applied to account for decay, waste and breakage. The 5 percent factor originates from estimates for older immature stands documented in the *1976 Metric Diameter Class Decay, Waste and Breakage Factors*.

OAF 2 is applied after OAF 1 and increases linearly over time from 0 percent at age 0 to the specified percentage at 100 years of age. If OAF2 were 5 percent, the increase rate would be 0.05% per year, reaching 5 percent at 100 years, 10 percent at 200 years, 15 percent at 300 years etc.

If better information is available, a custom or localized OAF could be used. Documentation supporting the proposed adjustments should be included in the data package.

Please include the following information:

- the magnitude of each factor;
- the yield table (analysis unit) to which each factor applies;
- the components that make up each factor;
- the source of the factors; and

- data to justify the magnitude of the factors (if not the accepted MoF standard).

Note that the Terrestrial Information Branch (MSRM) is currently developing a stand level decay model that will be available for use with the managed stand yield tables. When this model is available, one or both of the standard OAFs discussed above may be modified or replaced by information generated from the decay model.

5.5 Volume reductions

In mixed species stands, one or more species may be partially or completely unmerchantable. For example, the deciduous species in a predominantly coniferous stand may not be harvested, or may only be partially harvested. In these cases, the deciduous components should not contribute toward the estimated stand volume and cut control and should be excluded from the estimation of stand volume. Volume reductions have also been used where evidence indicates that the decay factors do not fully account for decay. In such cases, revision of the decay factors may be more appropriate and direct than a supplementary reduction to yield curves.

Document volume reductions by species, and explain how this reduction is modelled. For example, what is the percentage of the species volume to be excluded; and in which stand types does the exclusion apply?

The issue of non-utilized species in mixed stands applies mostly to existing stands. If similar issues could exist on managed stands, OAFs could be employed managed stands to capture them.

Table 27. Volume reductions

e.g. Leading species e.g. Analysis unit e.g. Type group	Problem species	Percent (%)
Total		

5.6 Other issues related to yield table development

To enable comprehensive archiving and review, it is useful to provide both the models used to generate timber yield tables, as well as the version numbers of the models.

Yield tables can be derived in a few different ways: (1) area-weighting yield tables generated for each polygon into an aggregate table; (2) employing average area-weighted attributes (e.g., site index, species composition) to generate a single table; and (3) using area-weighted inventory plot volumes for each analysis unit.

All yield tables, should be included as an appendix to the final analysis report.

5.6.1 Existing timber volume check

To verify that no errors were made in aggregation and that no significant aggregation bias exists, the total volume of the current (starting) inventory using polygon-specific inventory volumes should be compared to the total volume of the current inventory based on analysis unit volumes. If the difference is significant (over about 3 percent), the aggregation methods should be reviewed to determine the cause of the difference. Consider expanding the description to

show more detailed information such as volume by age class or by analysis unit and age class (see table below).

Table 28. Existing timber volume check

	Polygon volume derived using:		Percent (%) difference
	Inventory volume	Yield table (AU) volume	
Total volume (m^3)			

6 Silviculture

6.1 Silviculture management regimes

Information on silvicultural management regimes is needed to develop timber yield tables for regenerated stands. Sufficient information should be included in the data package to enable MoF staff to reproduce the proposed yield tables.

Silviculture performance information should be provided to support the management regimes that will be modelled in the base case. The following table provides an example summary format.

Table 29. Silviculture management regimes

Analysis unit	Area (hectares)	Leading species	Second species	Weighting (%)	SI	Establishment density (stems/hectare)		Regeneration delay (years)		Management	
Number/ name						Natural	Planted	Natural	Planted	e.g. Spacing (stems/ha @ age)	
e.g. 101		Fd	Cw	80/20	27		1600		2		
e.g. 102		Fd	Cw	80/20	20	3000		5		750 @ 20	

6.2 Regeneration delay

Regeneration delay is the time elapsed between harvesting and the time when stand growth begins. The delay incorporates both the time taken to establish a stand, and the age of seedling stock planted, if applicable. The data package should describe how the regeneration delays were estimated and how they will be applied in the analysis (e.g., in the yield tables, in the timber supply model, etc.). To ensure clarity, both the delay between harvesting and stand establishment and the age of planting stock should be provided.

Regeneration delay should be included in the time elapsed before the required green-up condition is attained that allows harvesting of adjacent areas. For more discussion of green-up, see Section 8.2, "Estimating green-up age."

6.3 Species conversion

If species conversion is part of the current management regime, the analysis will need to reflect that a site has a different site index for different species. If applicable, the methodology used to adjust the site index for each species should be described in detail.

If species conversions are proposed, include or provide a reference for applicable site index conversion equations, and provide site indexes for both the original and regenerated species. The DFAM group is encouraged to discuss options with the reviewing analyst or Research Branch specialists.

6.4 Stand rehabilitation

If currently non-merchantable or less desirable forest types (e.g., deciduous, stocking class 4 pine, etc.) are being rehabilitated to merchantable forest types, the data package should document how the conversion will be modelled.

Table 30. Stand rehabilitation

Existing analysis unit	Total area (hectares)	% area to be treated	Area to be treated (hectares)	Conversion schedule (hectares/decade[a])						Analysis unit regenerated to	Yield table regenerated to	Site index change
				1	2	3	4	5	6			

(a) Provide the area that will be converted each decade. If species conversion is modelled differently, provide a detailed explanation of the methods used.

Provide an account of the history of species conversion on the management unit, including area treated and rate of treatment (i.e., hectares/year). Describe the methods and attributes used to generate managed stand yield tables for the rehabilitated stands.

6.5 Gene resources — use of select seed

The Forest Practices Code requires the use of the best genetic quality seed and vegetative material source available for regeneration. The data package should describe the application of yield adjustments to account for the use of select seed; that is, seed with a known level of genetic gain (i.e., orchard & superior provenance seed sources).

Include an account of the historic, current and projected use of select seed on the management unit. Describe the availability of the select seed for the management unit and the likelihood that it will be available in the future. List any seed orchards operated by the licensee or agreements with seed orchards to procure select seed over time.

Describe how the genetic gain (i.e., Genetic Worth — GW) is applied in the yield tables or the timber supply model (e.g., applied in Table Interpolation Program for Stand Yields (TIPSY) or as an OAF or as a site index adjustment). GW is a measure of genetic gain for a given trait or attribute (e.g., G-Growth — height & volume). Describe when genetic gains will be applied during the forecast period and provide justification for the timing.

Table 31a. Genetic gain yield table (example)

Forecast period	Species	Area of application			Genetic gain applied (GW)	Genetic gain adjustment
		Analysis unit (AU)[3]	Elevation range (AU)	Seed planning unit (SPU)		
1-3	PLI		700 – 1500m	PLI NE LOW	10%	Adjusted up to account for Forecast GW
	SX		1300 – 1500m	SX NE MID	8%	Adjusted up to account for Forecast GW
	FDI		700 – 1500m	FDI NE LOW FDI NE HIGH	18%	Forecast GW applied; 85% MU above 1000m; adjusted down by 5% to account for limited seed supply
4-6						
7-25						

AU[3] Genetic Analysis Unit (GAU) may apply.

Table 31b. Seed use and genetic gain history table (example)

Species	Area of seed use		Select seed use	Genetic worth (GW)		Seed supply / access	
	Seed planning zone/unit (SPZ/SPU)	Elevation range (SPU)	Current[4]	Current[4] GW	Forecast GW[5]	Orchard / agreement (Yes/No)	SPU coverage to meet MU needs
PLI	PLI NE LOW	0 – 1400m	75%	7%	14%	Yes	100% in 2003
SX	SX NE MID	1000 - 1500m	96%	6%	8%	Yes	100% in 2003
FDI	FDI NE LOW FDI NE HIGH	0 – 1000m 1000+m	0% 0%	0% 0%	26% 22%	Yes	75% in 2013

Coastal species — GW at harvest rotation age of 60 years

Interior species — GW at harvest rotation age of 80 years

Current[4] Based on average historic/current seed use

GW[5] 10 year estimate from Species Plan Timeline Report

For more information:

Seed Use, Genetic Gain and Species Plan Timeline reports (current and forecast) can be obtained from MoF Tree Improvement Branch and will be soon be available (Sept /03) within

SeedMap, a new web-based map viewer and reporting application. Gene resource spatial data (i.e. SPZ, SPU and Seedlot) in ARC format is also available upon request. For more information on SeedMap, refer to the SeedMap home page at: http://www.for.gov.bc.ca/hti/seedmap). To request a SPAR & SeedMap client access Extranet ID, send an e-mail request to FORHTIP.SEEDHELP@gems9.gov.bc.ca.

6.6 Silviculture history (defining existing managed stands)

Document, for each analysis unit, the area by age class of existing managed second-growth stands within the management unit.

Table 32. Immature management history

Analysis unit		e.g., Natural (hectares) age class			e.g. Planted (hectares) age class			e.g. Spaced (hectares) age class			Total area (hectares)
#	Name	1	2	3	1	2	3	1	2	3	
1											
2											
etc.											

Explain how these stands are accounted for in the analysis (i.e., are they grown on MSYTs? How was site index assigned?). Assumptions made in the analysis about the history of management on the TSA should be substantiated with evidence (i.e., performance statistics).

Comment on current silviculture management performance relative to any silviculture treatments applied in the managed stand yield tables used in the base case.

6.7 Backlog and current not satisfactorily restocked

Backlog NSR is any area that was denuded prior to 1987 (when basic silviculture became the obligation of licensees) and is not yet fully stocked. All other NSR is considered current NSR.

Provide a summary of the areas in the timber harvesting land base that are backlog and current NSR and specify how and when these areas will be regenerated. If there are any plans for managing inoperable NSR area (i.e. outside the timber harvesting land base) discuss those plans and document the location and amount of the areas involved.

As background and support for the modelling approaches to be used in the analysis, provide an account of the history of current and backlog NSR area regeneration, including the area regenerated each year. Describe how and when NSR is regenerated in the timber supply model. Also, describe the method used to assign site indexes and yield estimates to the NSR area, and the logic used when assigning NSR to analysis units.

Table 33. Backlog and current NSR

		Backlog NSR		Current NSR		
Original analysis unit	Analysis unit regenerated to	Area (hectares)	Years until stocked[a]	Area (hectares)	Years until stocked	Total area (hectares)
1						
2						
Total						

(a) This column could alternatively be titled "Rate of restocking (hectares/decade)" or "Regeneration schedule" with the column subdivided into decades.

7 Unsalvaged Losses

Quantify the average unsalvaged (timber) losses that occur due to insect and disease epidemics, fire and blowdown. When modelling timber supply, the common practice in British Columbia is to add the unsalvaged losses estimate to the desired harvest requested for each decade, and then subtract the estimate from the forecast for reporting (i.e, the timber analysis focuses on timber supply for human use).

Unsalvaged losses are typically applied as a factor covering the entire unit. While often no better information is available, where it is, unsalvaged losses may be applied on a location specific and/or species specific basis.

Since unsalvaged losses are typically applied over the long term, the average loss should be derived from long-term historic data. The objective is to include in the average annual estimate, events that are known to occur periodically (e.g., 50-year wind storm events).

Unsalvaged losses estimates are best derived from local information, rather than using assumptions made for adjacent management units. In the data package, describe how the unsalvaged loss figures were derived (e.g., time frame, major outbreaks included, etc.). Include information detailing the extent of salvage operations if applicable.

Table 34. Unsalvaged losses

Location/species (zone, analysis unit)	Cause	Gross losses (m^3/year)	Volume salvaged (m^3/year)	Unsalvaged loss (m^3/year)
	Fire			
	Insects (Epidemic)[a]			
	Disease (Epidemic)[a]			
	Windthrow			
	Other			
Total				

(a) Endemic losses are reflected in the yield tables.

8 Resource Management Emphasis

Management strategies for specific forest resources are often expressed in terms of maintaining a desired age distribution of forest cover.

Forest cover requirements are typically expressed as follows:

- a maximum area (or percent area) (timber harvesting land base or productive) that may support stands younger than age X (or shorter than height Y);
- a minimum area (or percent area) (timber harvesting land base or productive) that must support stands older than age W (or taller than height Z);
- a minimum area (or percent area) (timber harvesting land base or productive) that must support stands between age U and age W.

It may be necessary or desirable to manage for two or more different forest related resources on the same area. As noted above in Section 4.1, "Management zones, groups and objectives", currently available timber supply models are designed to account for overlapping forest cover requirements. For example, landscape unit level old-seral objectives may overlap portions of areas where visual impacts are also managed.

With the requirement to retain different forest characteristics across the landscape, it is important to identify if productive forest outside of the timber harvesting land base might contribute to the area needed to satisfy a forest cover requirement (i.e., maximum allowable disturbance or minimum area retention).

If necessary, all types of forest cover requirements may be applied at the same time to the same zone, group or analysis unit.

Some common forest resource values for which management can be expressed in terms of cover requirements are: visual resources, ungulate winter range, landscape-level biodiversity objectives, and adjacency/green-up requirements.

The data package should contain descriptions of issues, information sources, assumptions, and any relevant data manipulations or adjustments related to management objectives and practices.

Include a description of the various management objectives that apply to the area and assumptions used to model the objectives (e.g., silvicultural regimes, utilization levels, seral forest cover requirements, extended "rotations," alternative harvesting systems). The description should specify the component of the land base to which the objective applies; for example, timber harvesting land base, or Crown forested area. The table below provides an example for describing the management regimes (forest cover requirements) and the areas subject to the requirements. All information would not necessarily have to be in a single table.

Table 35. Example table describing management for non-timber objective

Zone or group	Total Crown productive forest area (ha)	Timber harvesting land base (ha)	Green-up maximum allowable disturbance (%)	Green-up height (metres) or age (years)	Minimum older area (years)	Minimum area of older age retained (%)	Constraints applied to
VQO — preservation			1	5	—	—	Crown forested area in the zone
VQO — retention			3	5	—	—	Crown forested area in the zone
VQO — partial retention			10	5	—	—	Crown forested area in the zone
VQO — modification			20.5	5	—	—	Crown forested area in the zone
General resource management			40	3	—	—	Timber harvesting land base
Caribou habitat			—	—	140	40	Crown forested area within the zone
Landscape–level biodiversity			40	3	—	—	Timber harvesting land base

8.1 Forest resource inventories

Information and policies invariably change over time. As a result it seems reasonable to review and sometimes change the inventory information available for the timber supply analysis, including information that was deemed to be adequate for the last timber supply analysis. Having each of the inventories reviewed and accepted by the appropriate agencies prior to submitting the data package helps to reduce the number of questions and changes to the data package later on in the timber supply analysis process.

Where the inventory data related to forest management objectives are separate from the forest cover or vegetation resource inventory, document their status. Indicate what standard was used to complete each inventory, the date of completion or update, and approvals obtained.

Table 36. Forest resource inventory status

Forest resource inventory	Standard	Date completed/ updated	Date approved	Approved by	Status
e.g. Visual landscape					
e.g. Recreation					
e.g. Range					
e.g. ESA					
e.g. Stream					
e.g. Wildlife					
Other					

8.2 Estimating green-up age

Age to green-up can impact harvest scheduling opportunities based on minimum green-up height requirements. The age to green-up is an important operational scheduling parameter and a key element in timber supply analysis. Green-up age is used as a measure of tree height and site occupancy to meet visual, hydrological, wildlife or other objectives. Achievement of green-up height is often required before adjacent areas may be harvested.

Height-age curves have been used for timber supply analysis to approximate the age at which green-up heights are achieved. The MoF application *SiteTools* provides site index and height growth equations for B.C. commercial species. In addition, the MoF publication *Age to Green-up Height: Using Regeneration Survey Data* provides height-*versus*-age estimates by site index derived from data available in the Integrated Silviculture Information System (ISIS) along with a comparison of these green-up ages to those derived by *SiteTools*.

For areas and species for which *Age to Green-up Height* has sufficiently strong data, and where no better local information is available, the estimates in the document likely provide the best available information on age to green-up. Judging if data are sufficient is somewhat subjective. One consideration is that there should be several data points to support an age to green-up estimate (the plots in Appendix 4 of *Age to Green-up Height* are useful for assessing the strength of the data). For example, where the age–height curve has been interpolated between several points at an early age to one or two points at an older age, the interpolation beyond the early ages is probably weak. For example, see Nelson Cw, SI=15 (page A4-13) or Cariboo Sx, SI=9 (page A4-3) in *Age to Green-up Height*. In the absence of local data or strong estimates from *Age to Green-up Height*, *SiteTools* or similar height-age relationships should be used to determine age to green-up. In situations of uncertainty about which approach to use, the reviewing analyst should be contacted to arrange for discussions with MoF experts in Research and/or Forest Practices Branches.

8.3 Visual resources

The MoF publication *Procedures for Factoring Visual Resources into Timber Supply Analyses* (REC-029) was updated in March 1998 (available on-line at http://www.for.gov.bc.ca/hfp/PUBS/Visual/TSR10.pdf). These procedures should be consulted when determining appropriate forest cover requirements to apply for visual resources in the base case.

Forest Practices Branch is currently developing factors for adjusting forest cover objectives for scenic areas based on plan-to-perspective (P2P) ratios. When the P2P ratios have been finalized, the *Procedures for Factoring Visual Resources into Timber Supply Analyses* will be revised.

Under the *Forest Practices Code* (FPC), the intent was to "make known" scenic areas and establish visual quality objectives (VQOs) for them throughout the province. Currently the processes for identifying scenic areas are at various stages of completion. As described on page 3 of the procedures, for some districts scenic areas have been made known and VQOs established by the district manager or through a planning process (e.g., higher level plan). For some districts scenic areas have been made known but VQOs have not yet been established. For some, the visual landscape inventory has been completed but no scenic areas have been identified and made known. Nevertheless, in many of these areas visual resources are being managed, in some cases in accordance with a "district manager policy" letter or commitments made in local plans. The *Forest and Range Practices Act (FRPA)* will not change establishment and management of scenic values significantly except that in the future MSRM will be responsible for designating scenic areas as this seen as a land use decision. Under FRPA, scenic areas not grand-parented and which are not identified by MSRM will not be managed for VQOs.

For the base case, legally established objectives, on-the-ground current performance, district manager guidance and/or commitments made in plans should be reviewed to determine the framework within which visual resources are being managed in the management unit. This management framework should be described and if possible supported with documentation in the data package (attach any relevant instruction letters as an appendix to the data package).

Visually effective green-up heights should be determined using the procedures described in *Procedures for Factoring Visual Resources into Timber Supply Analyses* (Table 6) or based on current performance (operational approvals) or on direction from a planning process or the district manager.

Describe the geographic resolution with which forest cover requirements will be applied. For example, individual visual polygons, or by VQO class within landscape unit. The following table provides an example for describing the breakdown of the scenic area into VQO classes, and the forest cover requirements that will be applied for each VQO. More detail may be required where the VQO for each visual sensitivity unit (polygon) is accounted for separately.

Table 37. Visual resources

VQO	Productive (hectares)	Timber harvesting land base (hectares)	Green-up height (metres)	Green-up age (years)	Allowable denudation percent (%)
e.g. retention			e.g. 4	e.g. 22	e.g. 5%

8.4 Recreation resources

Recreation objectives may be identified in a higher level plan (e.g., landscape unit objectives or recreation site, trail or interpretative forest site objectives) or through the district manager making recreation features "known". Often, the best available information describing the recreation resource is the ESA inventory (see above under Section 3.2.7, "Environmentally sensitive areas").

Where recreation objectives are best represented in the model by the application of a forest cover requirement, please include in this section the rationale and the methods used in modelling the objectives.

8.5 Wildlife

8.5.1 Ungulate winter range

Ungulate winter ranges are areas that have been "identified as being necessary for the winter survival of an ungulate species". These areas may be identified through a higher level plan, by the deputy minister of MWLAP under *Section 69* of the *Operational Planning Regulation*, or by a wildlife management plan or strategy approved before October 15, 1998 by the district or regional manager and the designated environment official; the chief forester; or the authorized ministers.

The management objective for ungulate winter range typically includes the maintenance of thermal cover and/or old growth. In the model, this may be accomplished by removing the identified area from contributing to timber supply (see Section 3.2.10, "Wildlife Habitat-Land Base Reductions") or by applying forest cover requirements. Thermal cover is usually provided by stands that average a certain tree height. Thus, the forest cover requirement is expressed in terms of a minimum amount of the area identified as ungulate winter range being covered with stands that are within a certain age range, a surrogate for stand height.

Please describe the process that led to the identification and approval of the ungulate winter range and the rationale, method, agreement(s) or report(s) that were used to determine the forest cover requirement for winter range. Provide details on the area delineated as ungulate winter range (total, productive and timber harvesting land based) and describe (in tabular format and/or text) any land base reductions and the forest cover requirements that will be applied to the area.

Where the process for identifying ungulate winter range is incomplete, the effect on timber supply of managing the ungulate winter range (based on the best information available at the time the analysis is completed) should be investigated using sensitivity analysis.

8.5.2 Identified wildlife

Identified wildlife are managed through the establishment of wildlife habitat areas (WHA) and implementation of general wildlife measures (GWMs), or through other management practices specified in higher level plans. The procedures for establishing WHAs are described in *Managing Identified Wildlife: Procedures and Measures, Volume I*, February 1999. See on-line at http://wlapwww.gov.bc.ca/wld/identified/index.htm for more details on the IWMS.

Three species identified in the *Identified Wildlife Management Strategy* depend on habitat requirements that cannot be managed solely through WHAs because they have large home ranges, occur at low densities, have widely and sparsely distributed limiting habitats, or are sensitive to forest level disturbances. These species have been called "higher-level plan species" and include bull trout, fisher and grizzly bear. Management strategies for these species will most often flow from higher level plans.

The data package should list the identified wildlife species (including the "higher-level plan species") that exist or may exist in the management unit. Include the area of established WHAs and describe the GWMs that apply. Also describe any objectives or management strategies prescribed for the higher-level plan species. Explain the methods that will be used in the timber supply model to account for these measures and tabulate the forest cover requirements that will be applied in the base case and any proposed sensitivity analyses. The information provided should include the amount of area managed for the species of concern, the location or identification of the area (e.g., zone, group), and any land base reductions, volume reductions and forest cover requirements applied. If appropriate, summarize this information in a table.

Often, identified wildlife species have been sighted on a management unit and current management includes protection of their habitat (e.g., Queen Charlotte goshawk nesting sites), even though WHAs have not yet been established. Licensees should discuss with MSRM staff and the MoF reviewing analyst whether accounting for the management of these areas is best included in the base case or through a sensitivity analysis.

8.5.3 Caribou

Generally areas are identified for caribou management during the Land and Resource Management Planning (LRMP) process. This process is at various stages of completion for different areas of the province. Draft management strategies may be in place in areas where the LRMP in ongoing and higher-level plan objectives for caribou management have not yet been approved.

Describe the status of planning for caribou habitat and the current caribou management regime in the management unit. If available, provide any instructions issued by the district manager detailing her/his expectations for the management of this species.

Provide information detailing the extent of the area being managed for caribou, in terms of total land base, productive forest and timber harvesting land base. Explain what forest cover requirements are being employed in the field and how these will be reflected in the base case and/or in any planned sensitivity analyses.

8.6 Adjacent cutblock green-up

Describe the current operational requirements for cutblocks to achieve "green-up" before adjacent blocks may be harvested. Green-up conditions are commonly referenced to a minimum average tree height. In the timber supply model the stand height requirement is often expressed as the time needed to attain the height (green-up age). In some timber supply models that do not explicitly represent spatial relationships, the adjacency constraint is expressed in

terms of the maximum proportion of an area that may be covered with stands younger than the green-up age.

The area that is subject to the adjacency constraint is that portion of the timber harvesting land base (not the total managed productive forest) where harvesting is not otherwise constrained by objectives for specific non-timber resources. This area is often referred to as the Integrated or General Resource Management zone. Areas where harvesting is subject to a specific non-timber objective that is less restrictive than the adjacency constraint should, for modelling, be included in the area subject to the adjacency constraint.

In the data package, describe the rationale/method used to determine the number of years to achieve green-up, and the maximum area that may be covered with stands less than the green-up age (or height). See Section 8.2, "Estimating green-up age", for a discussion of tools and information sources for defining green-up age.

If a spatially explicit model will be used for the analysis, provide specific information about how adjacency constraints are to be incorporated in the model, for example, the definition of adjacency (contact, buffer width, etc). See Section 9.7, "Timber supply model" for more discussion on spatially explicit modelling.

8.7 Biodiversity

The *Landscape Unit Planning Guide* (LUPG), released in March 1999, consolidates policy direction and guidance on biodiversity management. It can be accessed online at: http://srmwww.gov.bc.ca/rmd/offices/landscape-watershed/lup/lup_landscape.htm

The LUPG should be consulted when developing the biodiversity assumptions to be used in the base case and sensitivity analyses.

According to the LUPG, biodiversity is managed at the landscape and stand levels. The primary mechanism for landscape-level management is retention of old-seral forest. Stand-level biodiversity is protected through retention of wildlife trees and patches. The following sections outline the policy framework and modelling issues associated with management for biodiversity.

8.7.1 Landscape-level biodiversity

8.7.1.1 Policy framework

Chapter six of the *Landscape Unit Planning Guide* describes the process to be followed when establishing LU boundaries and objectives. Currently draft LUs, and in many cases draft biodiversity emphasis options (BEO) are in place throughout the province. In some areas LUs and BEOs have been established pursuant to Section 4(1) of the *Forest Practices Code of B.C. Act*.

Retention of old growth is one of the two current priorities for LU planning. In accordance with the *LU Planning Guide (Chapter 3, Procedures for Preparing LU Objectives and Strategies)*, the recommended approach to developing old-growth retention is through the establishment of old-growth management areas (OGMA) and associated LU objectives that will ensure retention and/or recruitment of old-growth structure over time.

According to step one of this process (*LU Planning Guide* page 28), old-growth targets must be met using the non-contributing land base first. In addition, old-growth representation is to be managed at the biogeoclimatic ecosystem classification (BEC) variant level unless a resource management zone objective established as a higher level plan directs representation at a finer level or the chief forester permits an exception (*LU Planning Guide* page 28).

In LUs with a higher or intermediate-biodiversity emphasis, the intent is to achieve the entire old-growth target in OGMAs immediately. Where there is a deficit of old growth, recruitment OGMAs must be established so that the old-growth target will be achieved in the shortest possible time frame (*LU Planning Guide* page 30).

For LUs with a lower biodiversity emphasis, the OGMA target may be drawn down by two-thirds of the recommended targets (*LU Planning Guide, Appendix 2*). In lower emphasis areas, guidance is that only one-third of the OGMA target should be met immediately, unless it is determined through a timber supply analysis associated with the Timber Supply Review that a higher level of retention will not cause additional timber supply impacts (*LU Planning Guide* page 30).

For LUs with a lower biodiversity emphasis where the full OGMA target is not delineated and established, a recruitment strategy must be developed that describes how the target will be met by the end of the third rotation (*LU Planning Guide* page 30).

Appendix 2 of the *LU Planning Guide* details landscape-level biodiversity objectives and seral stage retention targets for each natural disturbance type (NDT).

8.7.1.2 Landscape units

Where the district manager has established LUs, they should be used in the base case. Where they have not been established, use the most recent draft LUs. Include in the data package a description of the status of the LU planning process. Unless a higher level plan indicates otherwise, if the management unit forms only a part of a LU, for the timber supply analysis the *LUPG* old-growth targets should be applied to the management unit portion of the LU. The assumption is that if each administrative unit separately meets the old-growth objectives on the portion of the LU it covers, the objectives will be met for the LU as a whole.

Where designated parks are located within the LU, a proportion of the old growth within the park may contribute to the old-growth targets for the management unit. The potential contribution of old-growth areas outside the management unit to the old-growth targets of the LU should be discussed with Forest Service district staff, MSRM staff and the MoF reviewing analyst before confirming the assumptions in the data package.

8.7.1.3 Biodiversity emphasis options and forest cover requirements

Where BEOs have been established for LUs, old-growth targets reflecting the established BEOs should be modelled in the base case. Old-growth targets are documented in Appendix 2 of the *LU Planning Guide*.

Where BEOs have not been established the BEOs in the Regional Landscape Unit Plan Strategy should be used. Where BEOs have not been established and no draft BEOs have been suggested, the government policy direction documented on page 9 of the *Biodiversity Guidebook* (September 1995) should be applied in the base case. According to the policy, approximately 45 percent of each LU will be in the lower BEO, 45 percent in the intermediate BEO and 10 percent in the higher BEO. As a result, in the base case the area-weighted average (i.e., 45/45/10) biodiversity constraints for the three BEOs should be applied for each variant in each draft LU. However, in some areas the LU planning process has advanced to an extent that a different approach for modelling BEOs in the base case may be more suitable. Licensees are encouraged to discuss potential options with the MoF reviewing analyst.

For established LUs with a lower BEO and for the lower BEO portion (45 percent) of the old-growth constraint in draft LUs, the target for the first rotation (80 years unless otherwise agreed to by the District Manager (DM) and Designated Environment Official) should be drawn down by 2/3. The objective is to attain the full old-seral target in three rotations (240 years) in

areas managed for a lower BEO. Usually the constraint applied in the model is 1/3 of the full old-seral target for the first rotation, 2/3 for the second and 3/3 for the third. The expectation is that this modelling strategy will ensure that after three rotations sufficient old growth will be available to satisfy the full old-seral target.

Where OGMAs have been established, they should be accounted for in the base case. Where the process is incomplete and only some OGMAs have been established, a forest cover requirement representing the old–seral objective would normally still be applied, with the OGMA contributing to the achievement of the target. The method to be used in the model for reflecting OGMAs in conjunction with the old-seral targets should be discussed with Ministry of Forests district staff, MSRM staff and the MoF reviewing analyst prior to submitting the data package.

In the base case, all old-growth targets should be applied at the biogeoclimatic variant level (unless a resource management zone objective directing representation at a finer level has been established as a higher level plan or the chief forester has permitted an exception).

Section 3.4, "Planning for Seral Stage Distributions (mature)" of the *Landscape Unit Planning Guide*, provides guidance on where mature–seral requirements apply (normally only natural disturbance types 3 and 4, unless doing so would affect timber supply).

The following table provides an example of the kind of information that should be included in the data package. If mature–seral requirements are to be applied, the corresponding ages and percentage retention values should be provided in a similar table.

Table 38. Old-seral targets

			Area (hectares)				Old seral constraint (% of productive)		
Landscape unit	BEC variant	NDT	Productive	Timber harvesting land base	BEO	Old age	1st rotation	2nd rotation	3rd rotation
X	ICHmk1	3	3 392	2 569	45/45/10	140	10.5	12.6	14.7
Y	ESSFwc2	1	5 978	5 125	Lower	250	6.3	12.7	19
Z	CWHmm1	2	4 826	2 591	Inter–mediate	250	9	9	9

8.7.2 Stand-level biodiversity — wildlife tree retention

8.7.2.1 Policy framework

One of the two priorities for LU planning is to establish LU objectives for wildlife tree retention.

Section 3.2 and Appendix 3 of the *Landscape Unit Planning Guide* (March 1999) detail the process for determining wildlife tree retention requirements at the subzone level in order to establish LU objectives. Varying from these procedures may be necessary where an established higher level plan exists and directs otherwise.

On May 15, 2000, the Assistant Deputy Ministers of Forests and Environment, Lands and Parks (now MSRM) approved changes to Section 3.2 of the *Landscape Unit Planning Guide*. Further detailed policy on management of wildlife trees is provided in the document *Provincial Wildlife Tree Policy and Management Recommendations* (February, 2000). The planning guide changes

and the recommendations are available on the MoF Forest Practices Branch web site at: http://www.for.gov.bc.ca/HFP/pubs/wildlife_trees/WLTpolicyfinalMay15-00.pdf

8.7.2.2 Operational planning for wildlife tree retention

For operational planning, the *Landscape Unit Planning Guide* (page 35a, note to step 4) states if OGMAs have not been established, Table A3.2 in Appendix 3 of the guide should be used to determine the level of wildlife tree retention required and if OGMAs have been established, Table A3.1 should be used.

8.7.2.3 Base case assumptions for wildlife tree retention

Wildlife tree retention may be accounted for through a land base deduction or a volume deduction. If the intention is to permanently retain wildlife trees, they should be accounted for through a land base reduction, and the method and information used described in the section on definition of the timber harvesting land base (Section 3). If wildlife trees will be replaced over time, a volume reduction at harvest may be more appropriate. Whichever approach is used, please describe and explain the rationale behind the method used to account for wildlife trees and patches.

The following table is an example of the information that should be included in the data package.

Table 39. Wildlife tree retention constraints

Landscape unit	BEC subzone	Forested area (hectares)	Timber harvesting land base (hectares)	% subzone available for harvest	% timber harvesting land base harvested	Total wildlife tree retention (%)	Timber harvesting land base retention area (hectares)
A	SBSdk	58 957	49 524	84	30	8	1 980
A	ESSFmc	13 709	10 967	80	10	6	439

8.7.3 Coarse woody debris

Current coarse woody debris (CWD) policy states that CWD should be managed within harvesting utilization standards. See CWD policies online at: www.for.gov.bc.ca/hfp/wlt/cwd-policy-01.htm, and Section 3.2 of the *LUPG*.

CWD management objectives should be defined in forest development plans and should be balanced with other, potentially competing, stand management objectives such as fuel management. At present forest companies are encouraged to leave behind as much CWD as possible provided it does not exceed the minimum utilization standards or interfere with other stand management objectives such as forest health.

In timber supply analysis for AAC determinations there is presently no need to account for CWD because the yield tables used to project timber supply only include the volume of timber that exceeds minimum utilization standards.

If and when a guideline or policy is developed that requires a level of CWD maintenance that exceeds minimum utilization standards, or if a higher-level plan objective dictates that a level of CWD maintenance exceeding minimum utilization standards is required, licensees should account for CWD volumes in the base case of the timber supply analysis. The assumptions used to account for CWD should be clearly described in the data package.

8.7.4 Objectives for patch size distribution

According the *Landscape Unit Planning Guide* (March 1999), planning for the temporal and spatial distribution of cutblocks (patch size) is not a short-term priority for biodiversity planning (*LU Planning Guide*, Section 6.1). According to Section 3.3 of the *Guide*, detailed procedures for assessing patch size are still being developed. Objectives for patch size should be tested as draft prior to legal establishment. Section 4.6 C further explains the process to be used for establishing draft objectives for patch size distribution.

If management for patch size is consistent with current performance it should be incorporated into the base case if possible. Any assumptions regarding patch management, including those used in sensitivity analyses should be clearly documented in the data package. In addition, the status of the process leading to establishment of patch size distribution objectives should be described.

8.7.5 Objectives for connectivity

According the *Landscape Unit Planning Guide*, Section 6.1, landscape connectivity is not a short-term priority for biodiversity planning.

According to Section 3.5 of the *Guide*, current policy directs that maintenance of connectivity should not have a timber supply impact. It must be accomplished through strategic location of the OGMAs, partial cutting strategies, the planned distribution of cutblocks and through existing constrained areas such as riparian reserve zones (*LU Planning Guide*, page 39). Legally established resource management zone objectives may influence how and where connectivity is managed. Where connectivity is addressed, it should be done through draft objectives and the implications to timber supply should be explored in sensitivity analysis.

8.8 Watersheds

8.8.1 Community watersheds

The data package should describe the objectives and modelling assumptions to be used for community watersheds. These should be developed in accordance with the *Community Watershed Guidebook* (October 1996). In developing modelling assumptions, particular attention should be given to Section 6, "Riparian management" and Section 8, "Harvest scheduling and cutblock size." Where watershed assessment information is available, it should be used to develop forest cover requirements for the community watersheds. Where no better information is available, the constraint described in Section 8.2.2 of the *Guidebook*, "Equivalent clearcut limits on sub-basins" may be used.

Table 40. Community watersheds

Name	Productive area (hectares)	Timber harvesting land base area (hectares)	Current equivalent clearcut area (ECA)	Allowable ECA	Forest cover requirement	
					Green-up age	Allowable denudation %

For watersheds where management is proceeding in accordance with completed watershed assessment procedures, assumptions should be included in the base case to reflect this management. The proposed method to be used in the base case to account for this management should be described in detail in the data package. A table similar to the example above should be included in the data package.

8.8.2 Domestic watersheds

The data package should provide information on any management provisions for domestic watersheds, such as protection of intakes from damage. Higher level plans may provide management provisions for domestic watersheds (e.g., Kootenay-Boundary Land-Use Plan), which should be reflected in the data package and analysis.

8.9 Riparian management zones

If an alternative approach to a land base exclusion is going to be used to account for riparian management zones (e.g., forest cover requirement or volume reduction), explain the approach in the data package. The following table is an example of the kind of information that should be included.

Table 41. Riparian management zones

					e.g., Forest cover requirement		
Zone	**Riparian class**	**Length or perimeter (kilometres)**	**RMZ width (metres)**	**RMZ area (hectares)**	**Minimum retention (%)**	**Age (years)**	**e.g., Volume retention (%)**
	e.g. S2	50	40	166	40	80	
	e.g. S4	96	60	472			10
	e.g. L3	5	30	8	25	120	

8.10 Higher level plans

The management objectives of any higher level plans that are in place should be described in this package along with the methods to be used to account for them in the timber supply analysis. Detailed information may be better described under the applicable section of the data package (e.g., Land Base or Resource Management Emphasis) and identified as being part of the higher level plan. In some situations it may be better to describe under one heading the higher-level plan objectives and the methods used to account for them in the analysis.

If the declaration of a higher level plan is imminent, or if management emphases associated with the plan are in draft form, it may be warranted to provide an option that demonstrates the timber supply implications of the imminent or draft plan. Proposed inclusion in the base case of draft higher-level plan assumptions should be discussed with the MoF reviewing analyst during the preparation of the data package.

8.11 Any other non-timber resource management

Licensees are expected to keep informed of new or revised management requirements for non-timber resources. Where and when these have potential implications to timber supply, they should be accounted for in the base case or in a sensitivity analysis. Licensees should discuss any new timber supply related issues with the MoF reviewing analyst during the preparation of the data package.

9 Timber harvesting

9.1 Minimum harvestable age/ merchantability standards

Identify the minimum criteria that stands within an analysis unit must meet to be eligible for harvest. In most cases, economic factors will dictate the threshold beyond which stands are available for harvest. For the purpose of timber supply modelling, these characteristics are often expressed in terms of volume per hectare and/or average diameter. In the timber supply model, the age at which the minimum threshold is attained is called the minimum harvestable age.

Note that these are minimum criteria, not the actual ages at which stands are forecast for harvest. Some stands may be harvested at the minimum thresholds to meet forest-level objectives (e.g., maintaining overall harvest levels for a short period of time or avoiding large fluctuations in harvest levels). However, other stands may be not be harvested until well past "optimal" timber production ages due to management objectives for other resource values (e.g., requirements for the retention of older forest).

Culmination age or some proportion thereof (e.g., 95 percent) has also been used in timber supply analysis as the threshold for minimum harvestable age. Whatever ages are chosen, they should be supported with a reasoned explanation. As a reference, culmination ages for each analysis unit should be included in a reference table (example below).

Table 42. Minimum merchantability standards

Zone/ group	Analysis unit	Minimum harvestable age (years)	Minimum average stand volume (m^3/hectare)	Minimum average stand diameter (cm)	Culmination		
					Age (years)	Average stand volume (m^3/hectare)	Average stand diameter (cm)

9.2 Harvest systems

Describe any considerations related to the harvesting systems employed in the management unit. For example, there may be a new operability classification that includes technologies, such as long-line or helicopter yarding, that have not commonly been used in the area. To help assess any timber supply issues associated with harvesting systems, document the contribution of the various systems to the timber harvesting land base (see table below). This may not be possible for the data package since the timber harvesting land base may not be defined; however, it should be included in the analysis report appendix.

The primary consideration is that if area will contribute to the timber harvesting land base in the analysis, harvesting performance should be documented.

Table 43. Harvest methods

Zone/ group	Harvest method	Area (ha) or Percentage contribution to THLB	Historic harvest contribution (m^3 or %)
	Ground-based (e.g., skidder)		
	Cable		
	Long-line		
	Helicopter		

9.3 Initial harvest rate

Explain the rationale and/or method used to establish the initial harvest rate for the base case. If applicable, this should also be explained for each option and/or sensitivity analysis. The most common consideration in TSAs is that woodlot licence AACs are not administered as part of the TSA. Therefore, the volume that has to been allocated to new woodlot licences from the TSA AAC since the previous determination is normally deducted from the starting level for the base case.

9.4 Harvest rules

Document the harvest rules that are used in modelling the base case and other options and sensitivity analyses. Several harvest rules have been used in timber supply analysis. For many harvest forecasts the absolute oldest stands are harvested first in the model. The use of the relative oldest first harvest rule is also widely used, whereby stands with the greatest difference between their age and their associated minimum harvestable age are harvested first. Other harvest rules intended to simulate more random harvest patterns are also used. For the base case, the rule applied should reflect current operational conditions.

Table 44. Harvest rule

Option/sensitivity analysis	Harvest rule	Description

In general, none of the harvest rule choices alone truly reflect operational conditions. Therefore licensees are encouraged to conduct sensitivity analysis to explore the impact on timber supply of using different harvest rules. The outcomes of these analyses should be discussed in the analysis in terms of their adequacy in reflecting actual operations.

9.5 Harvest profile

Document any information related to profiling or prioritizing of modelled harvests, other than the harvest rules discussed in the previous section, and minimum harvestable ages. For example, a profile may be specified in terms of a minimum or maximum target for area or volume harvested, or percent area or volume harvested per decade. Alternatively, areas specified for harvest in an existing operational plan could be prioritized for harvest in the model.

Table 45. Harvest profile

	e.g. Volume or area harvested by decade[a]			
Analysis unit	**1**	**2**	**3**	**4**
1.				
2.				
3.				
etc.				

(a) Or volume (m^3), area (hectares) by decade.

9.6 Silvicultural systems

List the silvicultural systems currently employed on the management unit by respective silvicultural regime. Certain practices may be geographically specific, such as selection harvesting, and these will have to be examined in relation to the corresponding forest cover requirements. Riparian management or wildlife considerations should also be described if a partial cutting system is prescribed.

Management strategies and the method proposed for incorporation in the base case and/or sensitivity analysis should be fully documented in the data package for each component of a variable retention management system.

If relevant, discuss the growth and yield effects, and methods used to account for those effects for each silvicultural system or component of a variable retention management system (e.g., shading effects, residual stand volume and growth).

Table 46. Silvicultural systems

Silvicultural system	Eligible analysis units or locations	Productive area (hectares)	Timber harvesting land base area (hectares)	% retention	# of entries	Time between entries (years)
e.g. Partial cut (RMZ)	Spruce types			50	1	80
e.g. Selection	All			70	3	30

9.7 Timber supply model

Provide information on the timber supply model(s) that will be used in the timber supply analyses.

- Model Name;
- Type (e.g. simulation, simulated annealing etc.);
- Description.

There are no specific requirements or limitations on which analysis models may be used. However, interpretation of results requires a detailed understanding of assumptions made in the model about relevant forest and forest management components and processes. The best method of gaining this understanding is to benchmark the model with FSSIM, or other models used and understood by Forest Analysis Branch staff. This is not to imply that FSSIM is a better model, or produces more accurate results than other models. It is simply the case that Ministry of Forests staff understand how FSSIM works, and can therefore use it as a basis for understanding how other models work. If the model to be used has not been reviewed and benchmarked by Ministry of Forests staff, the agreement holder should develop a review process in cooperation with Forest Analysis Branch or a regional timber supply analyst.

Even if a model has been benchmarked, relevant details of model functionality (e.g., utility weights in a simulated annealing model) still require documentation and explanation in the analysis report or supporting materials. If the model being benchmarked produces different results from FSSIM (or other models used and understood by Forest Analysis Branch staff), the agreement holder or its representative should be responsible for explaining the differences in detail in a technical document.

In addition to spatially implicit (aspatial) models, spatially explicit (spatial) models are now available for use in timber supply analysis. Information detailing the function of these models is necessary to help understand the implications of their use to timber supply projections. This information should include details on the criteria used to aggregate polygons into cutblocks (such as age limits, species composition, or management emphasis), and on how analysis unit-level assumptions such as minimum harvestable age and green-up age are applied at the cutblock level.

10 Timber Supply Forecast / Options / Sensitivity Analyses

This section provides a summary of the harvest forecasts to be provided. The set of assumptions pertaining to each option and sensitivity analysis will be covered in detail in later sections.

10.1 Base case

When reviewing timber supply for a management unit, a reference timber supply forecast is needed against which timber supply implications of different management assumptions and of uncertainty in data and assumptions may be measured. This reference harvest forecast is commonly referred to as the base case. It is based on current performance or a reasonable extrapolation of current performance. All considerations that guide design and implementation of forest practices, such as plans, guidebooks and permits, including requirements for the management of non-timber resources, current harvest systems and methods and silvicultural management regimes, should be considered when developing "current performance" assumptions for the base case.

10.2 Sensitivity analyses

The data and assumptions used in timber supply analysis are often subject to uncertainty. To provide a perspective on the impacts on timber supply of uncertainty in the data or assumptions, sensitivity analysis is commonly performed. Usually only one variable (data or assumption) from the information used in the base case is changed for each sensitivity analysis.

Experience with AAC determination has shown that "standard" sensitivity analyses — that is, those in which a variable is altered by a somewhat arbitrary amount such as 5, 10 or 20 percent — can prove very useful during AAC determinations when assessing the implications of uncertainties that have not been evaluated specifically in an analysis.

Common sensitivity analyses include:

- Timber harvesting land base —
  - ⇒ increased/decreased by 5,10, or 20 percent (percentage can relate to general sense of uncertainty in the area);
  - ⇒ changes related to specific uncertainties; e.g., related to marginal types, operability;
- Existing stand timber yields increased/decreased by 5,10, or 20 percent;
  - ⇒ changes related to specific uncertainties; e.g., audit or decay-study findings;
- Site productivity estimates adjusted to reflect new research and sampling (if not included in base case) — involves changes to volumes, green-up ages and minimum harvestable ages;
- Minimum harvestable ages (MHAs) increased/decreased by 10/20 years, or changed according to an alternative defining criterion (e.g., if base line MHAs derived using a minimum volume per hectare threshold, sensitivity analysis could examine the effect of culmination-based MHAs);
- Green-up ages increased/decreased by 5 or 10 years, or by some percentage;
- Forest cover requirements increased/decreased by some percentage; altered to upper and lower ends of a possible range (e.g., forest cover requirements for a given visual quality objective vary according to visual sensitivity and degree of visual design); or altered to reflect uncertainties in policy and implementation (e.g., landscape-level biodiversity requirements can be phased-in, or applied immediately; effect of different biodiversity emphasis levels could be assessed);

- Disturbance in the area outside the timber harvesting land base (non-contributing forest) — impacts of different disturbance assumptions (e.g., no disturbance, maintain existing age distribution, disturbance according to average natural disturbance cycles);
- Unsalvaged losses — different levels of losses reflecting level of uncertainty.

This list is not exhaustive. Not all types of sensitivity analyses may be required, and specific local conditions may warrant a type of analysis not mentioned above. The choice of sensitivity analyses should reflect local conditions and knowledge. It may be useful to consult with local staff from the MoF or other agencies to develop a list of priority sensitivity analyses to perform.

A complete analysis of the base case includes sensitivity analysis for most of the variables used in the base case. In the data package, provide a summary (example below) of the sensitivity analyses that are planned for the timber supply analysis.

Table 47. Planned sensitivity analyses

Zone/ group/ analysis unit subject to uncertainty	Sensitivity analysis	Magnitude of change
e.g. Timber harvesting land base (THLB)	e.g. Minimum harvestable age	+/– 10 years
e.g. Partial retention	e.g. Green-up age	+/– 2 years
e.g. Biogeoclimatic variant	Old-seral age	Old-seral age – 50 years

Where necessary, assumptions should be described in more detail.

During preparation of the analysis, more issues that warrant sensitivity analysis may become apparent. Licensees should use professional judgement to decide which sensitivity analyses are required to provide the chief forester with a good understanding of the timber supply dynamics of the unit.

10.3 Other options

In addition to the base case and sensitivity analyses, timber supply analyses may include options that quantify the impacts on timber supply of pursuing management directions that are different from current management. If options are planned, summarize the issue or management direction each option is intended to reflect (see table below). Sensitivity analysis may be warranted to provide a better understanding of the timber supply dynamics associated with each of the options.

In the data package, identify the differences between the assumptions in the base case and any planned option(s). Include land base information (e.g., land base reduction table) and any other relevant information in a similar format to the assumptions documented for the base case that will help describe the intent of the option.

Assumptions associated with each option may be summarized in a table, or if more detail is required, under a separate heading for each option at the end of the package.

Table 48. Options

		Proposed sensitivity analysis	
Option title	**Issue to be tested**	**Title**	**Range to be tested**
Base case (current management)	e.g. To model the harvest forecast based on current management practices, performance and currently enforced guidelines		
e.g. Non-conventional (helicopter)	e.g. Implications to timber supply of including "non-conventional" harvest areas in the timber harvesting land base.	e.g. (1) Increased area; (2) Reduced area.	e.g. Increase and reduce non-conventional area by 10%.

10.4 Harvest flow objectives

One of the requirements of *Section 8* of the *Forest Act* is that the chief forester consider the short and long-term implications to British Columbia of alternative rates of timber harvesting from the area. Several alternative flow forecasts that will enable the chief forester to assess short-, medium-, and long-term trade-offs should be provided in the analysis. Both the *Interim Standards for Data Package Preparation and Timber Supply Analysis* and *Harvest flow Considerations for the Timber Supply Review* available on the FIA website (http://www.for.gov.bc.ca/hcp/fia/landbase/tsa_ifpa.htm) describe considerations related to harvest flow.

If warranted, the data package could contain a discussion of harvest flow issues in the management unit, and sensitivity analyses planned to examine those issues.

10.5 Other

Include any other information not covered by this guide that may affect timber supply. If this information cannot be incorporated into the model, provide estimates of impacts on timber supply in the short-, medium- and long-term.

If this information is incorporated in the model, provide the information source operational requirements, performance information and discuss the modelling methods used.

Appendix 1 — Yield Table Guide

The review of yield tables is time consuming. A common standard for the submission of yield table data will facilitate the review undertaken by Research and Terrestrial Information Branch staff. The following is a suggested format:

Standard of submission

Submit yield table data in DOS compatible ASCII format;

Submit each table in a separate DOS file;

Submit all files (i.e., tables) in the same format; and

Use mnemonic naming conventions.

Format of yield table data file

Each file shall contain two main sections; the header information and the yield information as follows.

1) Header information

Describe each yield table using exactly 15 lines (blank lines are permitted). The following information is required in the header:

Identification (e.g., Title, Management Unit);

Site index (50 years breast height-age);

Initial planting or establishment density (stems/hectare);

Time and details of treatments (e.g., spacing, fertilizing, etc.);

Merchantable specifications (dbh limit, top diameter, and stump height);

Percentage reductions (if applicable) for decay, waste, and breakage. State if the tables are gross, or net of these reductions?

Other netdowns (e.g. %, m^3/hectare) for operational falldown (e.g., operational adjustment factors). Are tables gross or net of these reductions?

Regeneration delay contributing to total age;

Number of years to reach breast height;

Maximum mean annual increment (MAI) (year and amount).

2) Yield information

Supporting documentation should be included indicating how the yield tables were generated including all assumptions and which site index curves were used.

For yield tables generated using models other than variable density yield prediction (VDYP) or table interpolation program for stand yields (TIPSY), the following variables should be included in each table in the stated columns and starting on line number 16:

Column	Variable	Unit
1–5	Total age	Years
6–10	Top height	Metres
11–20	Total volume	Cubic metres per hectare
21–30	Merchantable volume	Cubic metres per hectare
31–40	Diameter	Centimetres (specify quadratic or arithmetic mean)
41–50	Mean annual increment	Cubic metres per hectare/year

Additional variables (if applicable) can appear in the remaining columns. The following format is suggested:

Column	Variable	Unit
51–60	Basal area	m^2/hectare
61–70	Density	Stems/hectare
71–80	Optional additional data	

Note: Use 80 columns maximum.

Example of standard format

The following example outlines the standard format for yield tables. The first 15 lines contain header information and the remaining lines contain the yield table data. The header information can be any format, but must use 15 lines.

In this example:

The first line of test after the dashed line indicates the first line of the file, and the dashed line after the column heading is marked every 10 columns for your convenience.

1. Header line containing any of the required information
2. Header line containing any of the required information
3. Header line containing any of the required information
4. Header line containing any of the required information
5. Header line containing any of the required information
6. Header line containing any of the required information
7. Header line containing any of the required information
8. Header line containing any of the required information
9. Header line containing any of the required information
10. Header line containing any of the required information
11. Blank lines permitted
12.
13. Tot Top Total Merch
14. Age Ht. Vol. Vol. Diameter MAI Other Var.>
15. ----------1----------2----------3----------4----------5----------6
16. 10 1.6 0 0 0.1 0
17. 20 4.7 24 0 2.5 0
18. 30 8.0 82 0 5.0 0
19. 40 10.8 142 20 7.6 0.5
20. 50 13.3 200 87 9.9 1.7
21. 60 15.3 254 161 11.9 2.7
22. 70 17.0 298 218 13.5 3.1
23. 80 18.4 335 265 14.9 3.3
24. 90 19.6 366 304 16.0 3.4
25. 100 20.6 388 339 17.1 3.4
26. 110 21.5 406 364 18.2 3.3
27. - - - - - -
etc. - - - - - -

Ministry approved yield table generation programs

TIPSY — A Table Interpolation Program for Stand Yields

Contact TIPSY Coordinator at:

British Columbia Ministry of Forests
Research Branch
Forest Productivity and Decision Support Section (FPDS)
P.O. Box 9519, Stn Prov Govt
3rd floor, 712 Yates Street
Victoria, B.C. V8W 9C2

Fax: 387-8197
Phone: 387-6718

VDYP — Variable Density Yield Projection System

Contact Supervisor, Growth and Yield Predictions at:

British Columbia Ministry of Forests
Terrestrial Information Branch
P.O. Box 9516, Stn Prov Govt
722 Johnson Street
Victoria, B.C. V8W 9C2

Fax: 387-5999
Phone: 387-6043

Appendix 2 — Acronyms

AAC	Allowable Annual Cut
Analysis	Timber Supply Analysis
AU	Analysis Unit
AUM	Animal Unit Month
BEO	Biodiversity Emphasis Options
BGB	Biodiversity Guidebook
CF	Chief Forester
CORE	Commission on Resources and Environment
CWAPS	Coastal Watershed Assessment Procedure System
DFO	Department of Fisheries and Oceans
DM	District Manager
ESA	Environmentally Sensitive Area
FEN	Forest Ecosystem Network
FES	Forest Ecosystem Specialist
FIZ	Forest Inventory Zone
FPC	Forest Practices Code
FRBC	Forest Renewal British Columbia
FSSIM	Forest Service Simulation Model
GIS	Geographic Information System
HLP	Higher Level Plan
IWAPS	Interior Watershed Assessment Procedure System
LRMP	Local Resource Management Plan
LU	Landscape Unit
MoF	Ministry of Forests
MP	Management Plan
MPR	Management Plan Review
MSRM	Ministry of Sustainable Resource Management
MSY	Maximum Sustained Yield
MSYT	Managed Stand Yield Tables
MWLAP	Ministry of Water, Land and Air Protection
NCC	Non-Commercial Cover
NRL	Non-Recoverable Losses
NSR	Not Sufficiently Restocked
NSYT	Natural Stand Yield Tables
OAF	Operational Adjustment Factor
OGMA	Old-Growth Management Areas
OGSI	Old Growth Site Index
PFG	Post Free Growing
PMP	Proposed Management Plan
PSP	Permanent Sample Plot
PSYU	Public Sustained Yield Unit
RIC	Resources Inventory Commission
RM	Regional Manager
RMZ	Riparian Management Zone
ROS	Recreation Opportunity Spectrum
RTEB	Resource Tenures and Engineering Branch
SBFEP	Small Business Forest Enterprise Program
SUD	Satisfactory User Days
TFL	Tree Farm Licence
THLB	Timber Harvesting Land base
TIPSY	Table Interpolation Program for Stand Yields
TSA	Timber Supply Area
TYP	Twenty-Year Plan
VQO	Visual Quality Objective